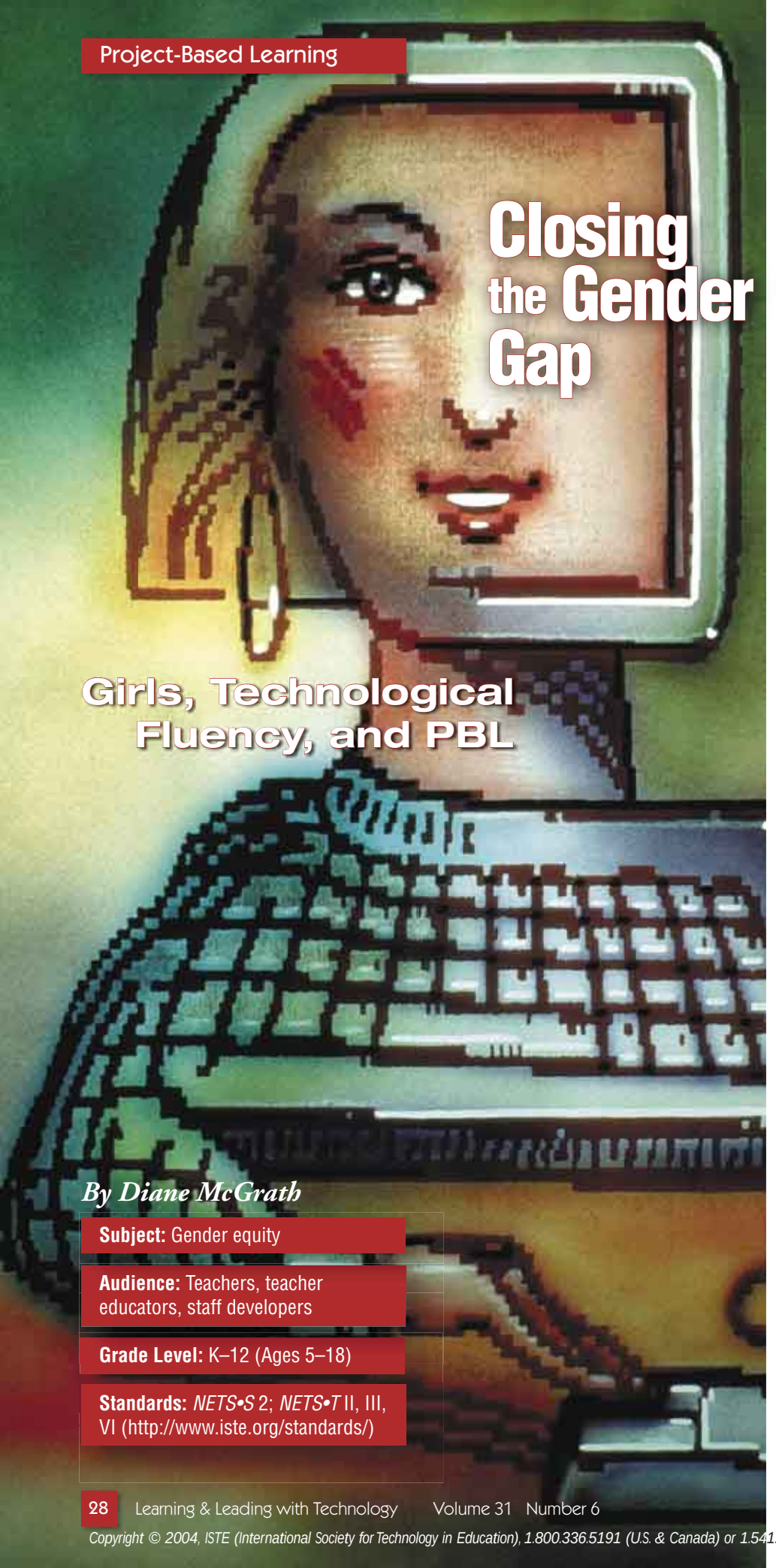

Closing the Gender Gap

Girls, Technological Fluency, and PBL

By Diane McGrath

Subject: Gender equity

Audience: Teachers, teacher educators, staff developers

Grade Level: K–12 (Ages 5–18)

Standards: *NETS•S* 2; *NETS•T* II, III, VI (http://www.iste.org/standards/)

Recently I read the book *Ghosts in the Machine: Women's Voices in Research with Technology,* and I was drawn into thinking about the well-known gender gap in the use of technology.

I hadn't looked at gender in technology use very closely in several years because in my own research, I had observed that girls like to use the new multimedia tools just as well as boys. (For more, see my research report at http://www.iste.org/jrte/28/5/mcgrath/article/.) However, I was reminded by *Ghosts* that technology is still a highly gendered field, and I began to think again about how we could set up learning environments to help encourage girls to explore these fields of study and work. I decided it was time to review the latest research about girls and technology in the classroom setting, particularly when they are involved in project-based learning (PBL). This month, I focus my column on technology fluency and gender equity: how do girls fare when using technology in a PBL environment?

PBL and Fluency with Information Technology

National Research Council (NRC). (1999). *Being fluent with information technology.* Washington, DC: National Academy Press. Available: http://www.nap.edu/books/030906399X/html/R1.html

The NRC's goal of *fluency with information technology* goes beyond the older notion of *computer literacy.* The NRC report focuses on the combination of contemporary skills, foundational concepts, and intellectual capabilities, not just on the skills of word processing and using spreadsheets.

A focus on skills alone does not prepare students for the swift changes in technology; students need a deeper understanding, they need to "express themselves creatively, to reformulate knowledge, and to synthesize new information." The NRC summary lists things students need to learn to do:

- Engage in sustained reasoning
- Manage complexity
- Test a solution
- Manage problems in faulty solutions
- Organize and navigate information structures and evaluate information
- Collaborate
- Communicate to other audiences

Does this begin to sound familiar? Here's more:

> Because FITness [fluency with information technology] is fundamentally integrative, calling upon an individual to coordinate information and skills with respect to multiple dimensions of a problem and to make overall judgments and decisions taking all such information into account, *a project-based approach to developing FITness is most appropriate.* [italics mine] Projects of appropriate scale and scope inherently involve multiple iterations, each of which provides an opportunity for an instructional checkpoint or intervention. The domain of a project can be tailored to an individual's interest … thereby providing motivation for a person to expend the (non-trivial) effort to master the concepts and skills of FITness. In addition, a project of appropriate scope will be sufficiently complex that intellectual integration is necessary to complete it.

Well! What does this tell us? Our students need to become more deeply involved with technology to enhance their understanding of what they are learning as well as to open doors to higher education and to job possibilities. How is this best accomplished? PBL! What's more, the next report shows us that PBL has particular significance for girls and technology.

Girls and Technology

American Association of University Women (AAUW). (2000). *Tech-savvy: Educating girls in the new computer age.* Washington, DC: Author. Executive summary available: http://www.aauw.org/research/girls_education/techsavvy.cfm

The AAUW Report found, not surprisingly, that girls do not like the computer game culture or the narrow and technical focus of computer science. Instead, they end up taking applications courses and generally disapprove of what they see as the machine focus of boys. As a result of this attitude, they do not experience the tinkering (bricolage) with programs that boys experience, an interest and a skill that better prepares people for designing software, not just using it. The AAUW commission recommendations for involving girls more in technology include encouraging tinkering for artistic and creative work, use of the computer across the curriculum (not just in computer science or applications classes), and "respecting multiple points of entry" into the field of technology. In addition, they direct our attention to the NRC's work on technological fluency and echo the NRC's call for PBL as a means to accomplish technological fluency.

In the next sections, I share findings from two studies about girls and project-based teaching and learning.

PBL, Girls, and Math

J. Boaler. (2002). Paying the price for "sugar and spice"—Shifting the analytical lens in equity research. *Mathematical Thinking & Learning*, *4*(2/3), 127–144.

Jo Boaler has done a good deal of research on involving girls more deeply in mathematics. She summarizes her findings from a previous important study:

> I monitored a cohort of students in each of the 2 schools over a three-year period, from when they were 13 to when they were 16. The two schools taught mathematics in completely different ways. At 13, before the students embarked on their different mathematical pathways, there were no significant differences in mathematical attainment of the two cohorts and there were no recorded gender differences at either school. Three years later the girls who attended the school that I have called Amber Hill, that followed a traditional, procedural approach, attained significantly lower mathematics grades on the national examination than the boys at their school. In the other school that I have called Phoenix Park, *where an open-ended, project based approach was employed,* [italics mine] there were no gender differences between girls and boys at any level, and the students attained significantly higher grades than the students at the more proce-

Thank You!

ISTE members are wonderful and generous. The *L&L* staff would like to especially thank the members who volunteered time from their busy NECC 2003 schedules to meet with us. Look for members like this month's subject, Mike Barton, in the new member profile section each issue on p. 46.

We'd also like to express our gratitude to **ISTE 100 member Intel** and its Innovation in Education program for providing Intel digital microscopes as gifts for the participants.

If you'd like to be the subject of a member profile next year, please contact us at **letters@iste.org.**

dural school. In questionnaires given to the students each year that asked them about their confidence and enjoyment, the boys at the two schools did not respond significantly differently. But the girls at the project-based school, Phoenix Park, were always significantly more positive and confident than the girls following a procedural approach at Amber Hill.

Boaler goes on to say that girls at both schools "sought a deep, conceptual understanding of mathematics, and those taught by teachers who encouraged the exploration of mathematical ideas were able to achieve this goal." She concluded that the problem with girls and mathematics was not primarily a problem girls have with the field of math, but in fact a problem they have with the traditional method of teaching math. By extension, I would expect that this would prove the same for science and technology, other subjects girls traditionally avoid. Learning environments that promote the sort of connectedness in understanding shown in Phoenix Park are likely to deeply involve girls in learning of subject matter they have hitherto avoided.

PBL, Girls, and Technology

C. C. Ching, Y. B. Kafai, & S. K. Marshall. (2003). "I always get stuck with the books": Creating space for girls to access technology in a software design project. In N. Yelland & A. Rubin (Eds.), *Ghosts in the machine: Women's voices in research with technology* (pp. 167–189). New York: Peter Lang.

This research takes us one step further into connecting the ideas of fluency, gender equity, and PBL. In this study, directly related to the deep uses and understanding of a programming environment for studying a subject matter, the researchers looked at how girls and boys worked in teams over a 10-week project. They anticipated that these mixed groups would be a problem for girls at first but that these problems would gradually go away.

To begin, fifth and sixth graders were teamed to design an astronomy project using MicroWorlds. Their completed project was to be suitable for teaching astronomy to younger students.

The researchers wanted to look at the participation of girls and boys in the different levels of activity that a project of this type required. They grouped the activities into three types:

- Traditional activities: researching the topic in books, drawing on paper, writing progress reports
- Constancy activities: using technology but not going very deeply into it, for example, researching the topic on a CD-ROM encyclopedia, word processing, watching others work in MicroWorlds
- Enriching activities: developing technological fluency, for example, actually doing the programming in MicroWorlds, researching the topic on the Internet, leading demonstrations of their project, teaching others to program

Early on, boys and girls participated at about the same level in constancy activities, girls did more traditional activities than boys, and girls did fewer enriching activities than boys.

The researchers thought that midway through the project, they would see some changes in participation. They were in for a surprise. During the fourth and fifth weeks, the girls reported that they didn't feel they had access to MicroWorlds, and when they did manage to get access, they didn't accomplish very much. Closer inspection of students working on the project indicated that the girls were taking time to get up and visit other computers to see what other students

were doing, share ideas and files, and otherwise collaborate with friends. According to the researchers,

> these gender differences did not remain constant throughout the ten weeks. There is another story to be told here however, and that is the story of *how* these changes in participation took place. The transition … was neither easy nor spontaneous; it required significant interventions by researchers and the classroom teacher.

To solve this problem, the researchers and teacher made some changes in the "spaces" in which the children were working; these eventually brought about a highly equitable learning environment for both girls and boys.

- Social space. They set up regular group meetings, led by the teacher, at which each person would speak about issues and problems they had in their work, and the whole group would address each issue. One result: they developed a computer schedule of who would do what when.
- Physical space. Instead of requiring students to take turns working at a few stations widely separated from each other in the classroom, they opened up the lab as well. Girls immediately started going to the lab to work without waiting for the teacher to tell them what to do. Boys more often stayed at isolated stations in the classroom.
- Cognitive space. In addition to team notebooks, they initiated individual designers' notebooks for students to record their own ideas. The girls often took these to the lab and worked from them.

After eight weeks, the researchers found little difference in the level of participation of girls and boys in the enriching activities, and both girls and boys did many fewer traditional and constancy activities.

Tying It Together

Where does this exploration of research on girls, fluency, and PBL leave us?

I think we have learned that girls want some things out of their studies that we hope all students will want: understanding, to see how things connect and why they work. Girls want to be able to participate, and they want the social, cognitive, and physical space in which to do so. They want to have their issues listened to and addressed. And when we do these things, when we teach in a connected way and take into account girls' need to engage deeply with the subject matter, then girls do fine work—even in math and technology, fields we always thought girls didn't like.

I also think Ching, Kafai, and Marshall are right on target when they conclude that our field is "reaching a point in gender and technology research where the issue may no longer be about *if* girls are using the computer but rather *how* they are using it." A good deal more research is needed on the factors that encourage both girls and boys to accomplish greater fluency with the technologies available to them and to be able to use them to benefit their understanding of the subjects they are studying.

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